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| AUTHORITY |
| USAFA ltr, 11 apr 1973; USAFA ltr, 11 apr 1973 |

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CONFIDENTIAL

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# USCONARC

# U.S. ARMY

# ARCTIC TEST BOARD

## Fort Greely, Alaska







Report of

EVALUATION OF SINGLE FLECHETTE AND

6.35-MM SIMPLEX AND DUPLEX AMMUNITION (U)

Date 7 MAY 1960 Project Nr. ATB 3-270

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US ARMY ARCTIC TEST BOARD
APO 733, Seattle, Washington

7 MAY 1960

ATBE-IN (P-ATB 3-270)

SUBJECT: Report of Project Nr ATB 3-270, Evaluation of Single Flechette and 6.35-mm Simplex and Duplex Ammunition (U), (DA Project Nr 5-04-05-002)

TO: Commanding General
United States Continental Army Command
Fort Monroe, Virginia
ATTN: DCofS for Materiel Developments

1. (U) AUTHORITY:

a. Directives:

(1) Ltr, ATDEV-3 474/15(C)(12 Oct 59), Hq USCONARC, 12 October 1959, subject: "Evaluation of Single Flechette (U)."

(2) Ltr, ATDEV-3 471/73(C)(22 Oct 59), Hq USCONARC, 22 October 1959, subject: "Evaluation of 6.35-mm Simplex and Duplex Ammunition (U)."

b. Purpose: To determine whether the Single Flechette and 6.35-mm Simplex and Duplex ammunition have sufficient military value to warrant further development for Army use under arctic winter conditions.

2. (U) REFERENCES:

a. Letter Report, Project Nr 2787 (Arctic)(C), US Army Arctic Test Board, 17 April 1959, "Letter Report of Evaluation of Small Caliber High Velocity Rifles (U)."

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b. Tentative Report of Test, Project Nr ATB 3-70 (C) USA Arctic Test Board, 24 March 1960, "Service Test of Cartridge, Ball, 7.62MM, M80(T233)," (DA Project Nr 55-040-5028)

3. (C) DESCRIPTION OF MATERIEL:

a. The Single Flechette is .22 in caliber and is of the discarding sabot type. The flechette weighs 10 grains and has a muzzle velocity of approximately 4,600 fps (Incl 1).

b. The 6.35-mm simplex bullet weighs 70 grains and has a muzzle velocity of approximately 3,300 fps (Incl 1).

c. The 6.35-mm duplex round contains 2 bullets weighing 53 grains each. Muzzle velocity of the lead bullet is approximately 2,650 fps and of the trail bullet approximately 2,450 fps (Incl 1).

4. (C) BACKGROUND:

a. The US Army has experimented for a number of years with projectiles of various calibers, velocities and configurations in an effort to improve the effectiveness of combat rifle fire. Principal approaches have been duplex and simplex bullets for standard calibers; small caliber high velocity bullets; and flechettes launched singly or in multiples.

b. One thousand rounds of Cartridge, 5.6-mm, XM110 (Single Flechette); 4,000 rounds of Cartridge, 6.35-mm, Ball, FAT 116E1 (Simplex); and 4,000 rounds of Cartridge, 6.35-mm, Ball, FAT 115 (Duplex), were received at this Board during the period 15-26 January 1960.

c. These items are not proposed for tripartite standardization.

5. (C) SUMMARY OF TEST RESULTS:

a. General:

(1) Weapons provided to fire the 5.6-mm and 6.35-mm cartridges were modified commercial sporting rifles and were not evaluated as hardware items.

(2) Comparative information listed for Cartridge, Ball, 7.62-mm, M59; Cartridge, Ball, 7.62-mm, M80; and Cartridge, Ball, Caliber .224 was extracted from reference 1a and 1b, or developed during conduct of this evaluation.

(3) Prior to conduct of any test, test ammunition was cold-soaked at an exposed storage site for 72 hours. Ambient temperatures during this period ranged from 19°F to -37°F. Test ammunition remained stored at this exposed site for the six weeks this ammunition was under evaluation. Ambient temperatures during this period ranged from 39°F to -37°F.

b. Test Nr 1 - Accuracy:

(1) Two riflemen, previously qualified as expert, fired three 10-round groups of each type test ammunition at a vertical target 20 feet x 20 feet at ranges of 300 and 500 yards. All groups were fired from a benchrest. Average maximum vertical spread (MV), maximum horizontal spread (MH), and maximum spread (MS) as well as mean radius (MR) obtained were as indicated below (inches). Ambient temperatures during firing of test ammunition ranged from 11°F to -13°F.

| TYPE AMMO | 300 Yards | | | | 500 Yards | | | |
|---|---|---|---|---|---|---|---|---|
| | MV | MH | MS | MR | MV | MH | MS | MR |
| Single Flechette | 22.70 | 32.37 | 36.12 | 10.96 | 45.62 | 47.04 | 61.09 | 17.49 |
| 6.35-mm Simplex | 11.91 | 11.91 | 14.33 | 4.64 | 25.25 | 24.00 | 30.41 | 9.52 |
| 6.35-mm Duplex Lead Bullet | 19.70 | 23.70 | 27.29 | 7.69 | 63.25 | 28.95 | 65.91 | 19.32 |
| *Trail Bullet | 43.66 | 51.04 | 59.00 | 21.74 | 84.04 | 95.75 | 102.75 | 40.97 |
| 7.62-mm M59 | 13.33 | 14.44 | 18.34 | 5.63 | 19.54 | 19.70 | 24.58 | 7.40 |
| 7.62-mm M80 | 12.01 | 8.01 | 12.29 | 3.88 | 13.87 | 12.70 | 17.87 | 5.84 |
| ** Cal. 224 | | | | | | | | |

* Center of impact of the trail bullet was 16.14" low and 2.32" right from center of impact of lead bullet at 300 yards, and 37.99" low and 5.00" right at 500 yards.

** Data not available.

(2) Five hundred-yard firing was repeated with the single flechette at ambient temperatures ranging from -15°F to -20°F. Average maximum vertical spread obtained was 61.65". Average maximum horizontal spread was 67.40." Average maximum spread was 87.15". Average mean radius was 25.34". A new stripper was put on the rifle prior to firing this exercise.

(3) Five hundred-yard firing was repeated with the single flechette at ambient temperatures ranging from -32°F to -36°F. With 1 group only 8 flechettes hit the 20' x 20' target, and with 3 groups only 9 flechettes hit the target. Average maximum vertical spread obtained was 55.6". Average maximum horizontal spread was 64.1". Average maximum spread was 74.5". A new stripper was put on the rifle prior to firing this exercise.

(4) During conduct of this test several flechette cartridge cases were bent while loading the round in the chamber. The cartridge case was made of very soft material and was easily bent (Incl 2).

(5) Twenty two rounds of single flechette failed to fire after three attempts.

(6) Seven rounds of single flechette showed evidence of improper assembly in that sabot parts were not seated equally (Incl 2).

(7) Silicone buffers in the bolt of the weapon provided to fire single flechette ammunition lasted an average of 15 rounds before misfires occurred.

(8) Fourteen large muzzle flashes approximately 12" in diameter occurred while firing the single flechette. All other flechette rounds fired produced greater muzzle flash than the Cartridge, Ball, 7.62-mm, M59 or M80.

(9) During initial firing by test personnel, six flechette rounds failed to hit a 16' x 16' target at 300 and 500 yards.

(10) Due to the flat trajectory of the single flechette, it was unnecessary to make elevation adjustments on the sight when firing at 300 and 500 yards.

(11) Two blown primers occurred during firing 6.35-mm duplex ammunition.

c. Test Nr 2 - Penetration:

(1) Ten rounds of each type test ammunition were fired into commercially dressed one-inch pine boards spaced in depth at one-inch intervals at ranges of 300 and 500 yards. Maximum, minimum and average number of boards perforated at each range were as indicated below. Ambient temperatures during firing of test ammunition ranged from 11°F to 0°F.

| | 300 Yards | | | 500 Yards | | |
|---|---|---|---|---|---|---|
| TYPE AMMO | MAX | MIN | AVE | MAX | MIN | AVE |
| Single Flechette | 24.0 | 8.0 | 15.4 | 19.0 | 9.0 | 13.8 |
| 6.35-mm Simplex | 27.0 | 22.0 | 24.6 | 14.0 | 11.0 | 11.3 |
| 6.35-mm Duplex Lead Bullet | 6.0 | 4.0 | 5.1 | 3.0 | 1.0 | 2.3 |
| Trail Bullet | 6.0 | 4.0 | 5.4 | 3.0 | 2.0 | 2.8 |
| *7.62-mm, M59 | 30.+ | 17.0 | 26.+ | 28.+ | 16.0 | 22.+ |
| **7.62-mm, M80 | 24.0 | 17.0 | 20.3 | 28.+ | 13.0 | 18.+ |
| Cal .224 | 22 | 19 | *** | 9 | 8 | *** |

* 50% of rounds penetrated 30-panel target at 300 yards, and 33-1/3% of rounds penetrated 28-panel target at 500 yards.

** 20% of rounds penetrated 28-panel target at 500 yards.

*** Data not available

(2) Ten rounds of each type test ammunition were fired into M1952 armor vests at ranges of 300 and 500 yards. Number of perforations obtained was as indicated below. Ambient temperatures during firing of test ammunition ranged from 5°F to -3°F (Incl 3).

| TYPE AMMO | 300 Yards | | 500 Yards | |
|---|---|---|---|---|
| | Near Side | Far Side | Near Side | Far Side |
| Single Flechette | 10 | 10 | 10 | 10 |
| 6.35-mm Simplex | 10 | 10 | 10 | 10 |
| 6.35-mm Duplex Lead Bullet | 10 | 10 | 10 | 0 |
| Trail Bullet | 10 | 10 | 8 | 0 |
| 7.62-mm, M59 | * | * | 10 | 10** |
| 7.62-mm, M80 | * | * | 10 | 10** |
| Cal .224 | * | * | 10 | 10 |

* Data not available.

** Fired at 800 yards.

(3) Ten rounds of each type test ammunition were fired into M1 steel helmets at ranges of 300 and 500 yards. Only impacts one-inch or more from the periphery of the helmet were counted as fair hits. Perforations obtained were as indicated below. Ambient temperatures during firing of test ammunition ranged from 7°F to -4°F (Incl 4).

| TYPE AMMO | 300 Yards | | 500 Yards | |
|---|---|---|---|---|
| | Near Side | Far Side | Near Side | Far Side |
| Single Flechette | 10 | 10 | 10 | 9 |
| 6.35-mm Simplex | 10 | 10 | 10 | 9 |
| 6.35-mm Duplex Lead Bullet | 10 | 10 | 10 | 0 |
| Trail Bullet | 10 | 7 | 9 | 0 |
| 7.62-mm, M59 | * | * | 10 | 8** |
| 7.62-mm, M80 | * | * | 10 | 6** |
| Cal .224 | * | * | 10 | 9 |

* Data not available.

** Fired at 800 yards.

(4) Ten rounds of each type test ammunition were fired into old, dry, hard, wind-crusted snow six inches in depth at ranges of 300 and 500 yards. All test rounds perforated the target. Ambient temperatures during firing ranged from 8°F to -19°F.

(5) Five rounds of each type test ammunition were fired into 18 inches of old, dry, hard, wind-crusted snow at a range of 500 yards. Results obtained were as indicated below. Ambient temperatures during firing ranged from 8°F to -19°F.

| TYPE AMMUNITION | PENETRATION (Inches) | | |
|---|---|---|---|
| | Min | Max | Ave |
| Single Flechette | 9 | 18 | 13.0 |
| 6.35-mm Simplex | 9 | 18 | 14.0 |
| 6.35-mm Duplex Lead Bullet | 9 | 10 | 9.2 |
| Trail Bullet | 9 | 15 | 10.4 |

(6) Five rounds of each type test ammunition were fired into six inches of solid ice at 300 yards range with results as indicated below. Ambient temperatures during firing ranged from 8°F to -19°F.

(a) Single Flechette - all rounds completely perforated; one round lodged in one-inch pine witness panel in rear of the target.

(b) 6.35-mm Simplex - all rounds completely perforated.

(c) 6.35-mm Duplex -

1. Lead Bullet - four rounds completely perforated and one penetrated four inches.

2. Trail Bullet - all rounds completely perforated.

(7) Three rounds of single flechette were fired into eight inches of solid ice at 500 yards range. All flechettes perforated the target. Ambient temperature was -16°F.

(8) All flechettes recovered from penetration targets were badly deformed (Incl 5). Approximately 50% of all flechettes tumbled in each penetration target medium.

d. Test Nr 3 - Sabot Distribution and Penetration:

(1) Ten rounds of single flechette were fired into a 20' x 20' vertical target at 5 and 10 yards. Five rounds were fired at 15 yards. Number of sabot particle impacts and average distance of sabot particle impacts from flechette impact was as indicated below. Ambient temperatures at time of firing ranged from 13°F to 7°F.

| Range (Yds) | Number of Rounds from Which Following Number of Sabot Particles Hit Target | | | | | Average Distance (Inches) |
|---|---|---|---|---|---|---|
| | 4 | 3 | 2 | 1 | 0 | |
| 5 | 10 | | | | | 31.9 |
| 10 | 2 | 4 | 2 | 2 | | Not Computed |
| 15 | 1 | | | 2 | 2 | Not Computed |

(2) Ten rounds of single flechette were fired into one-inch commercially dressed pine panels spaced in depth at one-inch intervals at a range of five yards to determine sabot particle penetration. Of the sabot particles which hit the 6' x 6' target, 13 penetrated 1/8-inch, five penetrated 1/4-inch, three penetrated 1/2-inch, and five perforated the first panel and dented the second panel. Ambient temperature was 29°F.

6. (C) DISCUSSION:

a. Single Flechette - Assuming that the design of this type ammunition could be refined to provide a higher degree of point target accuracy, many advantages could be gained by adoption of this type of round. Uppermost of these is the capability of providing the individual soldier with a small, extremely light weight weapon with effectiveness generally equal to the 7.62-mm caliber. This type ammunition will also permit the individual soldier to carry a considerably greater number of rounds within the same weight and bulk as now required for 7.62-mm ammunition.

b. 6.35-mm Simplex - This type ammunition performed similarly to the current standard Cartridge, Ball, 7.62-mm, M59 in areas where comparatively tested. A weapon of lesser weight and the same general effectiveness as the M14 rifle could conceivably be developed to fire this cartridge. A greater number of rounds of this type ammunition could be carried by the individual soldier within the same weight and bulk as 7.62-mm ammunition.

c. 6.35-mm Duplex - No real military advantage could be gained by adoption of this cartridge due to lack of accuracy and penetration capability.

7. (C) CONCLUSIONS:

a. The Cartridge, 5.6-mm, XM110 (Single Flechette) and the Cartridge, 6.35-mm, Ball, FAT, 116E1 (Simplex) have sufficient military value to warrant further development for Army use under arctic winter conditions.

b. The Cartridge, 5.6-mm, XM110 (Single Flechette) shows more promise for Army use under arctic winter conditions than the Cartridge, 6.35-mm, Ball, FAT, 116E1.

c. The Cartridge, 6.35-mm, Ball, FAT, 115 (Duplex) does not have sufficient military value to warrant further development for Army use under arctic winter conditions.

8. (C) RECOMMENDATIONS:

a. The Cartridge, 5.6-mm, XM110 (Single Flechette), and Cartridge, 6.35-mm, Ball, FAT, 116E1 (Simplex) be considered to have sufficient **military** value to warrant further development for Army use under arctic winter conditions.

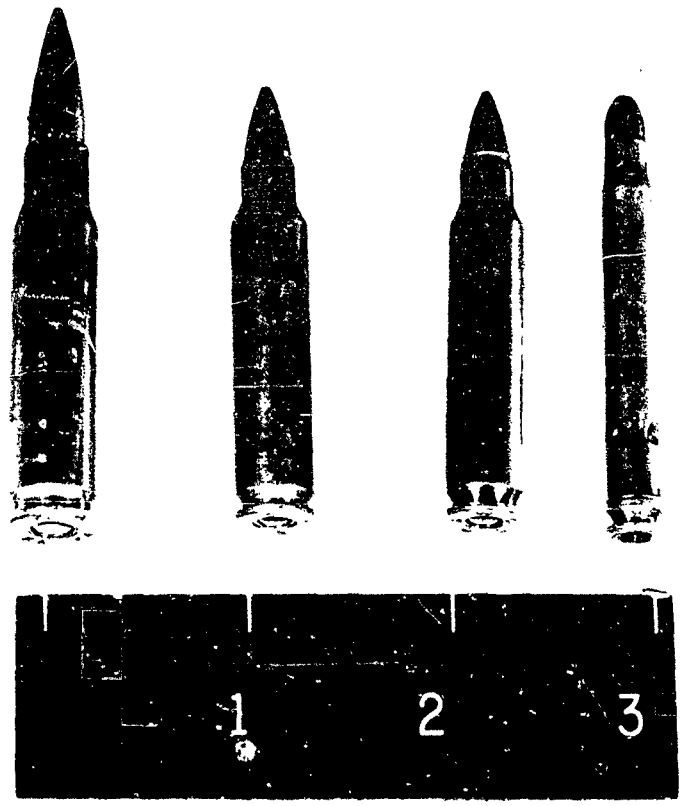
b. The Cartridge, 5.6-mm, XM110 (Single Flechette) be considered preferable to the Cartridge, 6.35-mm, Ball, FAT, 116E1 for development for Army use uncer arctic winter conditions.

c. The Cartridge, 6.35-mm, Ball, Fat, 115 (Duplex) be considered unsuitable for further development for Army use under arctic winter conditions.

DURED E. TOWNSEND
Colonel, Infantry
President

6 Incl

1 thru 5 - Photographs
6 Coordination




# US ARMY ARCTIC TEST BOARD

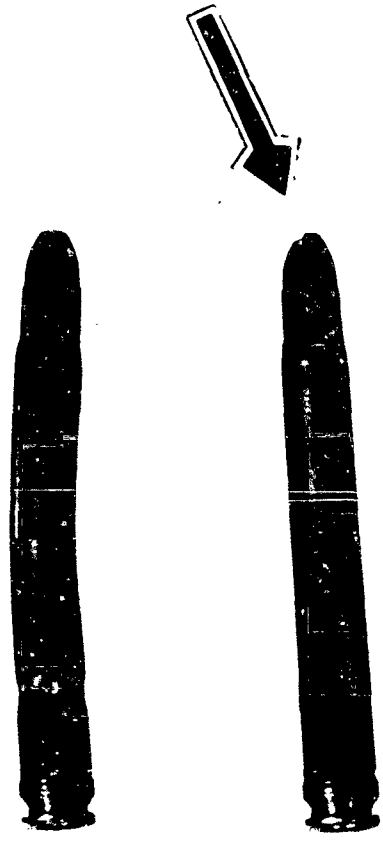
## FORT GREELY ALASKA

PROJECT NR ATB 3-270 25 FEB 60 NEGATIVE NR 141

SINGLE FLECHETTE AND 6.35-MM SIMPLEX
AND DUPLEX AMMUNITION (U)

LEFT TO RIGHT: CARTRIDGE, BALL, 7.62-MM, M59
CARTRIDGE, BALL, 6.35-MM, FAT 116E1 (SIMPLEX)
CARTRIDGE, BALL, 6.35-MM, FAT 115 (DUPLEX)
CARTRIDGE, 5.6-MM, XM110 (SINGLE FLECHETTE)

INCL. 1



# US ARMY ARCTIC TEST BOARD

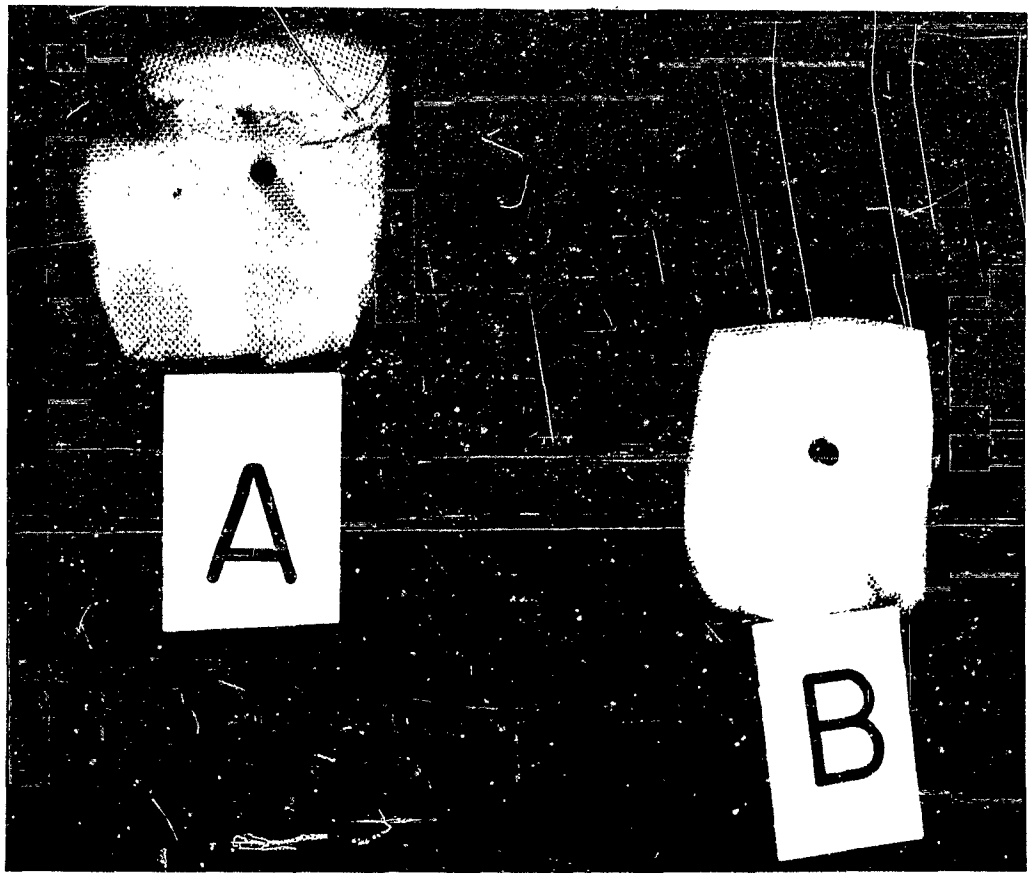
## FORT GREELY ALASKA

PROJECT NR ATB 3-270 4 MAR 60 NEGATIVE NR 156

SINGLE FLECHETTE AND 6.35-MM SIMPLEX
AND DUPLEX AMMUNITION (U)

LEFT : BENT FLECHETTE CARTRIDGE CASE
RIGHT: MALALIGNED SABOT

INCL.2



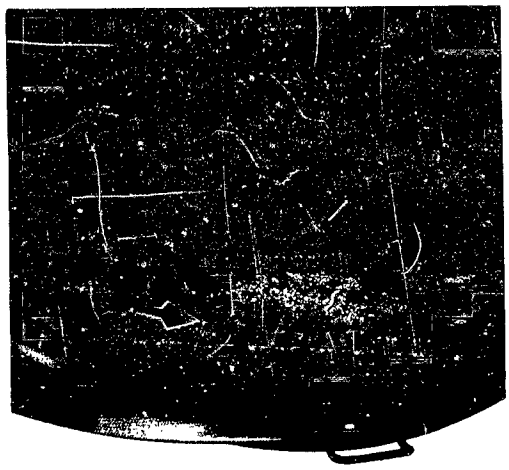

US ARMY ARCTIC TEST BOARD

FORT GREELY ALASKA

PROJECT NR ATB 3-270 3 FEB 60 NEGATIVE NR 92-3

SINGLE FLECHETTE AND 6.35-MM SIMPLEX
AND DUPLEX AMMUNITION (U)

A. LEAD DUPLEX BULLET LODGED IN FAR SIDE M1952 VEST
B. TRAIL DUPLEX BULLET LODGED IN FAR SIDE M1952 VEST



# US ARMY ARCTIC TEST BOARD

## FORT GREELY ALASKA

PROJECT NR ATB 3-270 3 FEB 60 NEGATIVE NR 92-5 92

SINGLE FLECHETTE AND 6.35-MM SIMPLEX
AND DUPLEX AMMUNITION (U)

LEFT: LEAD DUPLEX BULLET LODGED IN FAR SIDE OF M1 STEEL HELMET (500 YARDS)
RIGHT: TRAIL DUPLEX BULLET LODGED IN NEAR SIDE OF M1 STEEL HELMET (500 YARD)

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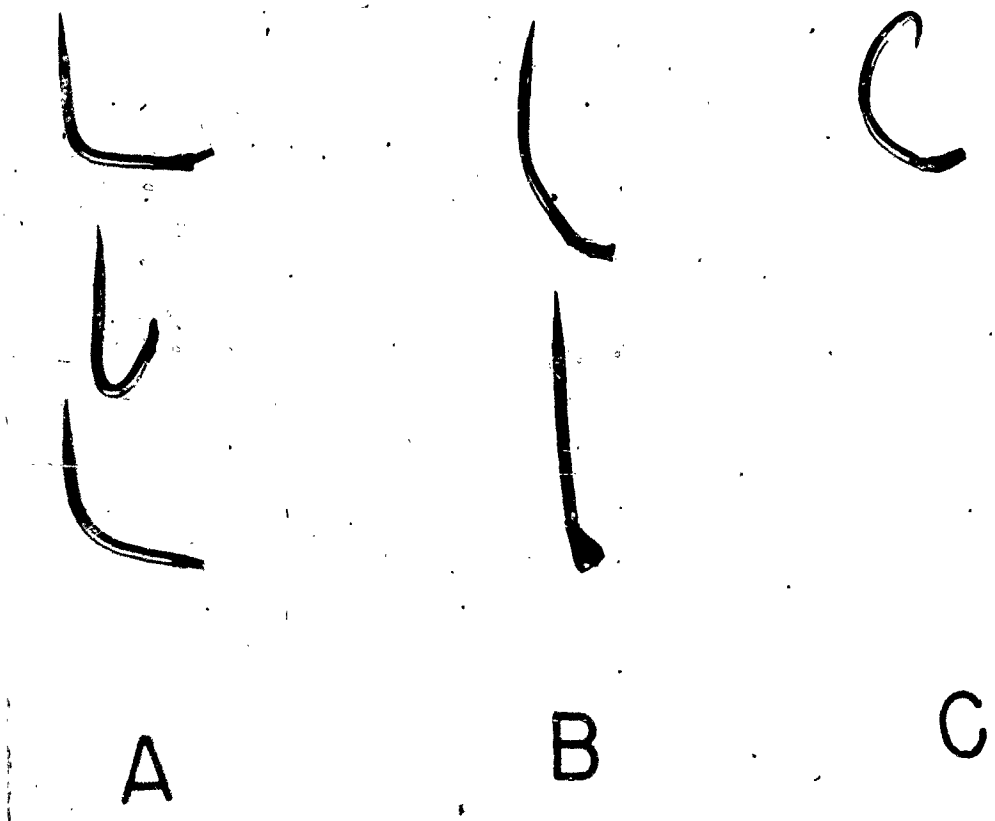
INCL.4

CONFIDENTIAL




## US ARMY ARCTIC TEST BOARD

FORT GREELY ALASKA

PROJECT NR ATB 3-270 8 MAR 60 NEGATIVE NR 164

SINGLE FLECHETTE AND 6.35-MM SIMPLEX
AND DUPLEX AMMUNITION (U)

A. SINGLE FLECHETTES RECOVERED FROM PINE TREES
B. SINGLE FLECHETTES RECOVERED FROM OLD, DRY, HARD, WIND-CRUSTED SNOW
C. SINGLE FLECHETTE RECOVERED FROM SIX INCHES OF SOLID ICE

CONFIDENTIAL

INCL. 5

INCLOSURE 6 - COORDINATION

(AGENCIES OUTSIDE OF HEADQUARTERS USCONARC)

REPORT OF TEST - PROJECT NR ATB 3-270

1. The US Marine Corps Landing Force Development Center replied but made no comment.

2. The following agencies did not reply and concurrence is assumed:

a. Chief of Ordnance, Department of the Army

b. United States Army, Alaska

c. Headquarters, US Marine Corps

d. British Liaison Officer, USCONARC

e. Canadian Liaison Officer, USCONARC